REEXAMINATION OF THE WARRAWOONA GROUP FOSSILS (TOWERS FORMATION, WESTERN AUSTRALIA, 3.3 TO 3.5 GA): ANALOGS OF MARS METEORITE FOSSILS?. Penny A. Morris[1], Carlton C. Allen[2], Everett K. Gibson[3], David S. McKay[3], and Kathie Thomas-Keprta[2]. [1]Dept. Nat. Sci., University of Houston-Downtown, 1 Main St. Houston, Tx., 77002, smithp@dt.uh.edu, [2]Lockheed-Martin Corp., Houston, Tx., 77258, [3]NASA Johnson Space Center, Houston, Tx, 77058

As part of our broad study of biomarkers, which may be useful in a search for possible life on Mars(1), we are investigating fossil remains in Archean rocks previously shown to contain a variety of microbial remains. Our study focuses on the chemistry, mineral composition and fossilized organic remains of bacteria and presumed cyanobacteria from the Warrawoona Group, Towers Formation (~3.5 Ga) (2,3,4,5). We are utilizing both scanning electron (SEM) and light microscopy. Freshly broken surfaces of rock chips that were coated with gold-palladium for 30 seconds were used for the SEM studies..

The sample, 002, is a stromatolitic carbonaceous chert that was obtained from the Precambrian Paleobiology Research Group (6). Hematite, quartz, barite, and relict carbonate minerals have been previously reported from this location (6). We confirm the presence of this mineralogy , including iron carbonate (siderite) .

We observed a presumed fossil assemblage including both filaments and coccus shaped forms. Filaments are present in both the petrographic section and SEM mounts. The filaments are diverse, encompassing those described by previous authors (7, 8). One of the filaments observed in SEM, that closely resembles *Eoleptonema* (7,8), is particularly striking. It is long and narrow, measuring 1.8 to 2.1 μm wide and over 100 μm long. SEM images also show coccus-shaped features with a diameter of 1.8 μm to 2.1 μm which we propose to be fossilized microorganisms (Fig. 1). These microorganisms are found in close association with the filament. Other coccoid forms along this filament show a partial splitting or girdling around the circumference of the coccoid. Coccus-shaped microorganisms as small as these have not been previously described from the Towers Formation. Energy dispersive x-ray analysis (EDS) shows that both the coccoid forms and filament are enriched in C relative to the background rock. The filament is also enriched in Si compared to the background. Fe and Al are present in the spectrum of both forms.

Other possible microfossils varied from a spheroidal to elongate to elliptical shape. Based on their size they cou ld be divided into three groups:

The largest, (group 1) have a spheroidal shape, and an external morphology reminiscent of a ball of yarn. Their diameters vary from 26 μm to 33 μm (Fig. 2). These may be the sheath enclosed cyanobacterial colonies described by Schopf and Packer (10). None were found that were as large as the single 50 μm specimen described by Schopf (8). If they are colonial, as Schopf suggests, these may all be the same species, but are composed of a variable number of individuals. Schopf and Packer included organisms in this grouping that were as small as 16 μm (10). EDS analysis of group 1 shows high Fe, C, and O, with lesser Si, S, and Ba. These forms may be mainly iron carbonate, possibly inte rgrown with barite.

Our group 2 consists of coccoid forms ranging from 16-18μm (Fig. 2). They lack the coarse surface texture of group 1, but exhibit a complex fine-grained texture. Composition is primarily Fe and O, with lesser C and some Si. These forms may be mainly iron oxide, possibly intergrown with iron carbonate.

Group 3 varies from 5 μm to 12 μm, but may have more than one morphological form. Surface morphology includes depressions and pointed protuberances (Fig. 3). These forms, if fossil microbes, are probably assignable to *Archaeospheroides* (10). The composition of group 3 is similar to group 2. Group 3 is mainly iron oxide, possibly with associated iron ca rbonate.

Conclusions :

1. Optical and SEM examination reveals a variety of filament and coccoid forms that resemble the fossils previous ly described in these samples.

2. Based on morphologies, sizes, and compositions, we propose that these features represent Archean microfossils. While they are all mineralized, they apparently retain a high carbon signature.

3. The presumed microfossils are not randomly distributed throughout the sample, but appear to occur in distinct assemblages, i.e., the filament resembling *Eoleptonema* and the coccus shaped forms are closely associated .

4. Fossilized organic remains, although predominantly oxides, carbonates, and silicates, include varying amounts of metallic ions. It has been proposed that the preservation of bacteria is enhanced by the retention of metallic ions, partic ularly iron (11).

5. Scanning Electron Microscope and EDS analysis, combined with optical microscopy, can produce a wealth of detailed information on fossil remains of microorganisms. Development of these techniques may provide new insight into ancient terrestrial life as well as possible life on Mars.

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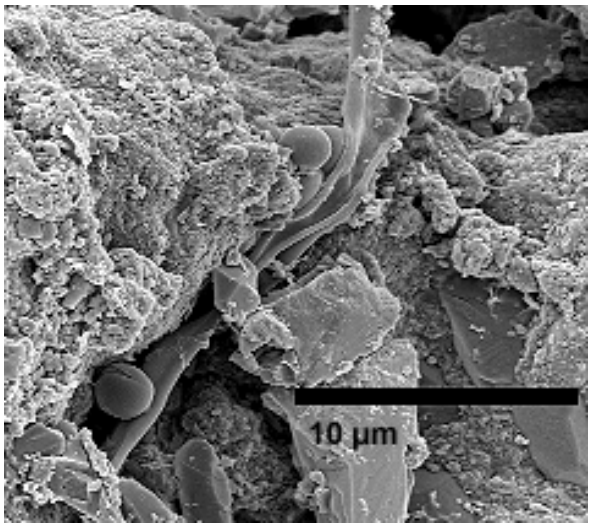

Figure 1. The filament *Eoleptonema*? extends from the top to the bottom of the micrograph. Paralleling the filament are coccus-shaped micr o organisms.

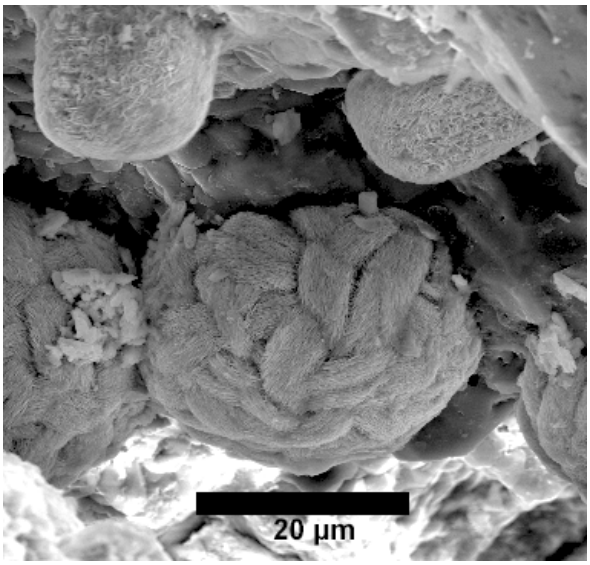

Figure 2. Large spheroidal ball is in center with parts of two others flanking it. Balls resemble a ball of yarn and appear to be those described by Schopf and Packer (10). At the top of the micrograph are elongate forms that were included in Group 2.

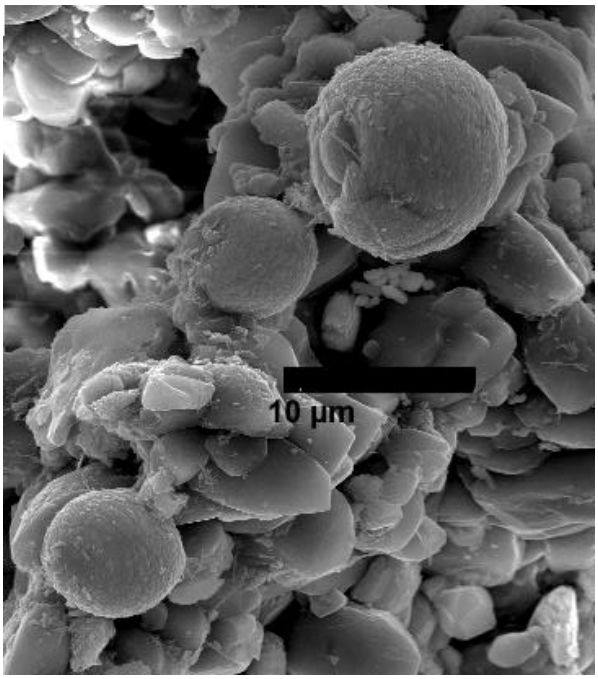

Figure 3. *Archaeospheroides*?. At the top of the micrograph is a spheroid with a claw-like extension. The bottom two spheroids either represents the opposing surface of organisms similar to the one at the top, or represent another species.